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ABSTRACT

In this research report, the influences of handedness, hand position while writing, and familial sinistrality (presence of left-handed relatives) on children's intellectual, reading, and visual-motor performance were investigated. Forty left- and right-handed children between the ages of 7 and 10 served as subjects. To assess hand positions, an index was devised, reflecting whether the subject's pencil pointed away from the body (normal position), was approximately parallel to an imaginary line drawn shoulder-to-shoulder through the body (horizontal position), or pointed toward the body (inverted position). Subjects' history of familial sinistrality was assessed through parent questionnaires; their intellectual functioning was measured by the Slosson Intellectual Test. Subtests of the Science Research Associate Achievement Test Battery and the Wechsler Intelligence Scale for Children-Revised were used, respectively, to assess subjects' reading ability and visual/motor performance. Results indicated that left- and right-handed children with horizontal hand positions had lower scores on reading ability than their counterparts who had inverted or normal hand position. Furthermore, both left- and right-handers with a positive history of familial sinistrality had higher IQ and spelling scores than children with no such history. Finally, no group differences in visual-motor performance were noted. Results are discussed in terms of hemispheric organization and the developmental reading process. (Author/MP)

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Left-handers and Cognitive Proficiency

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Abstract

In this research, the influences of handedness, hand position while writing, and familial sinistrality (presence of left-handed relatives) on cognitive deficit were investigated. 40 left-handed and 39 right-handed children between the ages of 7-10 served as subjects. Results indicated that hand position in both left- and right-handers is related to reading and spelling ability, i.e., left- and right-handed children with horizontal hand position had lower scores than their counterparts who had inverted or normal hand position. Further, both left- and right-handers with a positive history of familial sinistrality had higher IQ and spelling scores than children with no familial sinistrality. Finally, there were no group differences in visual-motor performance. These results are discussed in terms of hemispheric organization and the developmental reading process.

Left-handers and cognitive proficiency

Left-handers, like members of other minority groups, have been regarded with distrust and suspicion through the ages. Earlier in this century, this "sinister" population had been considered to be mentally deficient, reading-disabled, and lacking in visual-motor skill. Bakan (1973) proposes that all left-handedness is essentially pathological in nature. He states that pre-natal and neonatal trauma account for most of left-handedness.

Other investigators have taken a more moderate position on the question of the etiology of left-handedness. Satz (1972) proposes that there are two distinct populations of left-handers: those who are pathological because of birth trauma, and those who have inherited the genetic characteristic of left-handedness. This notion has been studied by comparing various characteristics of left-handed subjects who have left-handed relatives (familial sinistrality) with characteristics of left-handed subjects with no history of familial sinistrality (FS). Mixed results have been reported. Some studies (e.g. Bradshaw & Taylor, 1979) indicate that left-handers with no FS have language deficits, while others (e.g. Briggs, Nebes & Kinsbourne, 1976) report that both left- and right-handers with FS had lower IQ scores than their counterparts who had no FS.

Finally, the variable of hand position while writing has been implicated in the notion of inferior performance. McKeever & Hoff (1979) report that left-handers who use the inverted position appear to have a visual-motor dissociation of the cerebral cortex. Gregory & Paul (1980) found that left-inverted writers showed deficits in psycho-educational tasks involving

Left-handers and cognitive proficiency

vocabulary, picture-completion, and visual-motor performance. In contrast, Allen & Wellman (1980) reported that among right-handed children, those who used a non-normal, or horizontal position, had lower reading scores than right-handed children who used the normal (non-inverted) position.

The present study was undertaken to compare the intellectual, reading and visual-motor performance of left- and right-handed children with either normal, horizontal or inverted hand position and either a positive or negative history of FS.

Subjects

All of the left-handed children except two between the ages of seven and ten, and a random sample of right-handed children of the same ages from a rural New England school district served as subjects. There were 40 left-handers and 39 right-handers.

Procedures

To assess hand positions, a hand position index was devised based upon whether the subject's pencil during writing pointed away from the body (normal position), was approximately parallel to an imaginary line drawn shoulder-to-shoulder through the body (horizontal position), or pointed toward the body (inverted position). Each subject wrote a total of ten sentences, five at each of two sittings. The average sentence length was five words (Spache readability = grade level 1.5) and all words were from the Dale List of 769 Easy Words. Subjects first read each sentence aloud, and then copied it on the line underneath. As the subject wrote the sentence, the rater scored

Left-handers and cognitive proficiency

the subject's hand position as 1, 2 or 3 for normal, horizontal or inverted. The subject's index is the sum of these ratings for the ten sentences. The index thus ranges from 10-30.

History of FS was assessed by a parental questionnaire concerning left-handedness in the child's maternal and paternal family, including grandparents, aunts, uncles and siblings.

To measure intellectual functioning, the Slosson Intelligence Test, composed of items from the Stanford-Binet, was used. This test is individually administered, non-reading dependent, and yields a ratio IQ.

In order to measure reading ability, the appropriate levels of the Vocabulary, Reading Comprehension and Spelling subtests of the SRA Achievement Test battery were administered. The grade equivalent scores were used in all analyses. To correct for a non-balanced distribution of ages, Age was used as a covariate in the analyses performed, IQ was used as a second covariate to partial out the effect of intelligence on reading ability.

Visual-motor performance was assessed by the WISC-R Block Design subtest. Subtest scale scores were used in all data analyses.

Results

Left-handers were as intelligent as right-handers, and there was no difference among the five handedness/hand position groups (left inverted, left horizontal, left normal, right normal, right horizontal). However, there was a significant effect of FS on intelligence among both right- and

Left-handers and cognitive proficiency

left-handers. As Table 1 indicates, in all handedness/hand position groups except the left normals, those subjects with FS had higher IQ scores than subjects without FS. In a 2 X 5 ANOVA with FS and handedness/hand position as independent variables, these differences were highly significant ($F = 11.1$, $df = 1/69$, $p < .001$).

Hand position indexes reading ability. Children (both left- and right-handed) with horizontal hand position had lower Vocabulary, Reading Comprehension, and Spelling scores than did children with inverted or normal hand position. (Tables 2 through 4 show the mean scores adjusted for Age and IQ). In analyses of covariance with FS and handedness/hand position as independent variables and Age and IQ as highly significant covariates, this effect of hand position was significant for each subtest: Vocabulary ($F = 2.8$, $df = 4/67$, $p < .033$), Reading Comprehension ($F = 3.4$, $df = 4/67$, $p < .014$), and Spelling ($F = 3.3$, $df = 4/67$, $p < .016$). In addition, FS had a significant effect on Spelling scores ($F = 6.9$, $df = 1/67$, $p < .011$). Children with a positive history of FS had higher Spelling scores than did children with no FS. It is interesting to note in the Vocabulary and Reading Comprehension analyses, that when IQ is not entered as a covariate the same significant effect of FS appears, but when IQ is entered as a covariate, the effect disappears for Vocabulary and Reading Comprehension, but not for Spelling.

To investigate the hypothesis that left-handers have defective visual-motor skills, a 2 X 5 analysis of variance with FS and handedness/hand position as independent variables and the Block Design scores as the dependent

Left-handers and cognitive proficiency

variable was computed. Mean scores are shown in Table 5. Left-handers showed no significant difference in proficiency from right-handers and there was no difference in handedness/hand position or FS groups (all $p > .11$).

Discussion

These results indicate first that left-handers are not different from right-handers in intelligence, but all children, both left- and right-handers, who had a positive history of FS had significantly higher IQ scores than did children without FS. This finding is a direct contradiction to that of Briggs, Nebes & Kinsbourne (1976) who found that college students, both left- and right-handed, with FS had lower IQ scores than college students without FS. Because of the restricted range of intelligence in their sample, their results may not be generalizable to the entire population. As the Slosson Intelligence Test is mostly verbal in content, and because both left-handers and right-handers with FS have more bilateralization of language functions in the cerebral cortex than do individuals without FS (Hecaen, DeAgostini & Monzon-Montes, 1981), it may be that participation by both left and right hemispheres in language functions enhances language skill. This kind of notion was proposed by both Levy (1969) on the subject of language proficiency, and Witelson (1977) in the area of visuospatial performance.

In addition to the finding of equal intellectual performance of left- and right-handers, it also appears that left-handers as a group do not suffer reading disability. However, both left- and right-handed horizontal writers had significantly worse Vocabulary, Reading Comprehension and Spelling

Left-handers and cognitive proficiency

scores than their inverted or normal hand position counterparts. This finding replicates Allen & Wellman (1980) and Wellman (1979), who reported that right-handers with horizontal hand position had significantly lower reading scores than children with normal hand position. The fact that the horizontal hand position subjects (both left- and right-handed) had significantly lower scores than the normal or inverted subjects may be attributable partly to maturational factors. As Allen & Wellman reported, the incidence of horizontal position decreases with age, and virtually disappears by age 10 among right-handers. If younger children with horizontal hand position do suffer developmental lag, which manifests itself in reading disability, the reading problem may persist long after the hand position has changed to normal or inverted because of cumulative deficit of skills. The higher scores on the part of subjects with FS may again be explained by the bilateralization of function creating increased language and thus reading proficiency.

Finally, no deficit in visual-motor skills on the part of left-handers is seen. Block Design scores showed no significant differences among handedness/hand position or FS groups.

In conclusion, left-handedness is not a marker of cognitive skill deficit, but both hand position and FS appear to be variables related to such deficit.

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Table 1
IQ as a Function of Writing Hand/Hand Position
and Familial Sinistrality

Writing Hand/ Hand Position	FS	
	+	-
Left Normal	$\bar{X}$ 96.8	100.3
	SD 12.0	11.9
	N 4	4
Left Horizontal	$\bar{X}$ 105.9	97.2
	SD 14.6	13.3
	N 11	9
Left Inverted	$\bar{X}$ 109.2	108.3
	SD 5.8	5.7
	N 5	7
Right Normal	$\bar{X}$ 112.5	95.6
	SD 9.2	8.5
	N 8	13
Right Horizontal	$\bar{X}$ 110.6	102.8
	SD 10.6	10.6
	N 9	9

Table 2
Vocabulary Grade Equivalent Scores as a Function of
Writing Hand/Hand Position and Familial Sinistrality*

Writing Hand/ Hand Position		FS	
		+	-
Left Normal	$\bar{X}$	3.9	5.0
	SD	2.1	1.7
	N	4	4
Left Horizontal	$\bar{X}$	3.3	3.5
	SD	1.3	2.4
	N	11	9
Left Inverted	$\bar{X}$	4.9	3.9
	SD	3.0	2.2
	N	5	7
Right Normal	$\bar{X}$	3.9	3.7
	SD	1.8	1.8
	N	8	13
Right Horizontal	$\bar{X}$	3.2	2.6
	SD	1.8	1.9
	N	9	9

*Means adjusted for Age and IQ

Table 3
Reading Comprehension Grade Equivalent Scores as a Function of
Writing Hand/Hand Position and Familial Sinistrality*

Writing Hand/ Hand Position	FS		
	+		-
Left Normal	$\bar{X}$	4.2	4.6
	SD	.8	1.7
	N	4	4
Left Horizontal	$\bar{X}$	3.5	3.2
	SD	1.7	1.6
	N	11	9
Left Inverted	$\bar{X}$	5.0	4.6
	SD	1.9	2.5
	N	5	7
Right Normal	$\bar{X}$	5.1	4.3
	SD	1.8	2.7
	N	8	13
Right Horizontal	$\bar{X}$	3.7	3.0
	SD	2.2	2.0
	N	9	9

*Means adjusted for Age and IQ

Table 4
Spelling Grade Equivalent Scores as a Function of
Writing Hand/Hand Position and Familial Sinistrality*

Writing Hand/ Hand Position		FS	
		+	--
Left Normal	$\bar{X}$	4.1	3.1
	SD	1.3	1.5
	N	3	4
Left Horizontal	$\bar{X}$	3.8	2.3
	SD	2.4	1.9
	N	7	5
Left Inverted	$\bar{X}$	5.1	4.2
	SD	3.7	2.9
	N	4	6
Right Normal	$\bar{X}$	3.8	3.0
	SD	2.1	2.6
	N	8	10
Right Horizontal	$\bar{X}$	3.0	1.6
	SD	1.9	1.3
	N	7	7

*Means adjusted for Age and IQ

Table 5
Block Design Scale Scores as a Function of
Writing Hand/Hand Position and Familial Sinistrality

Writing Hand/ Hand Position	FS	
	+	--
Left Normal	$\bar{X}$ 8.7	9.0
	SD 1.3	1.6
	N 4	4
Left Horizontal	$\bar{X}$ 10.9	10.4
	SD 3.3	2.6
	N 11	9
Left Inverted	$\bar{X}$ 11.2	9.7
	SD 2.8	3.2
	N 5	7
Right Normal	$\bar{X}$ 11.6	8.3
	SD 1.7	2.9
	N 8	13
Right Horizontal	$\bar{X}$ 9.6	10.3
	SD 1.3	3.2
	N 9	9